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(54) **TRAFFIC BOTTLENECK DETECTION AND CLASSIFICATION ON A TRANSPORTATION NETWORK GRAPH**

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CPC **G08G 1/0133** (2013.01); **H04W 4/027** (2013.01); **H04W 4/028** (2013.01); **H04W 4/046** (2013.01)
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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,206,641 A * 4/1993 Grant et al. 340/905
5,732,383 A * 3/1998 Foladare G08G 1/0104
455/456.5
6,408,005 B1 * 6/2002 Fan H04L 12/5602
370/412
6,813,555 B1 * 11/2004 Kerner G08G 1/0104
701/117
8,681,614 B1 * 3/2014 McCanne H04L 47/522
370/230
8,804,521 B1 * 8/2014 Dubois-Ferriere H04L 47/10
370/235
2014/0222321 A1 * 8/2014 Petty et al. 701/117
* cited by examiner

OTHER PUBLICATIONS

Chen, "Systematic Identification of Freeway Bottlenecks", Transportation Research Board, 83rd Annual Meeting, Jan. 2004 Washington, DC, Jul. 30, 2003.

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(57) **ABSTRACT**

Traffic congestion detection, classification and identification includes analysis of link-speed data representative of vehicular speed and capacity on one or more roadway segments to determine non-linear, multi-segment traffic bottlenecks in a transportation network graph. Link-speed data is processed to detect bottleneck conditions, classify bottlenecks and bottleneck-like traffic features according to their complexity, and identify sustained or recurring bottlenecks. Such a system and method of traffic congestion detection, classification and identification provides a framework for using this link-speed data to detect the head and queue of bottlenecks on a directed graph representing the transportation network, classify the resulting bottlenecks and bottleneck-like traffic features according to the shape of their queue, and identify and measure sustained or recurrent bottlenecks even when the location, or head, of the bottleneck varies slightly across multiple time periods or across multiple days.

25 Claims, 7 Drawing Sheets

